

# Answer KEY

NAME \_\_\_\_\_  
DATE 12/09  
HOUR \_\_\_\_\_

## PHYSIOLOGY OF THE HUMAN BODY BOHB-4

### HUMAN DIGESTIVE SYSTEM

The human body plan is basically a tube-within-a-tube design, with the digestive tract formed by the inner tube. There are specialized organs along the length of the digestive tract that carry out the breakdown of food.

**mouth, pharynx, and esophagus** Food enters the digestive system through the mouth. In the mouth it is chewed and broken down by the teeth into smaller pieces. It is also mixed with *saliva*, which contains the enzyme *ptyalin*. Ptyalin digests some of the starch to maltose. The saliva also serves to moisten the food and make it easier to swallow.

From the mouth, food passes to the *pharynx*, or throat, and from there into the *esophagus*. The breakdown of starch that begins in the mouth continues in the pharynx and esophagus, but no other digestive changes occur in this portion of the digestive tract.

### Questions

1. What mechanical changes in the food take place in the mouth?  
*grinding / chewing (change in size)*
2. What chemical changes in food take place in the mouth?  
*Ptyalin breaks down starch*
3. What structures produce saliva?  
*Salivary gland, sublingual gland, submandibular gland*
4. What digestive enzyme is present in saliva and what is its function?  
*Ptyalin changes starch into maltose*
5. Chew a piece of cracker or pretzel thoroughly and hold it in your mouth for a minute or two. What taste change occurs? Why?  
*Will taste sweet since it changes starch to sugar*
6. How is food moved down the esophagus?  
*peristalsis*

**stomach** From the esophagus, food passes into the *stomach*, a muscular sac with sphincter muscles at either end. The *cardiac sphincter* controls the passage of food between the esophagus and the stomach, and the *pyloric sphincter* controls the passage of food from the stomach into the small intestine.

The inner lining of the stomach contains tiny *gastric glands*, which secrete gastric juice. Gastric juice contains hydrochloric acid and the enzyme *pepsin*, which begins the digestion of protein. Contraction of the muscles of the stomach wall churn the food around and mix it with gastric juice. Food is retained in the stomach until it is completely liquefied. When it reaches this condition, it passes through the pyloric sphincter into the small intestine.

## Questions

1. What structures control the passage of food into and out of the stomach?  
*sphincters ... gastroesophageal & pyloric*
2. What chemical changes in the food occur in the stomach?  
*Proteins are broken down into dipeptides.*
3. The enzyme secreted by the gastric glands is pepsin.
4. How does the hydrochloric acid of the stomach help protect the body against disease?  
*Kills bacteria that can be found on food.*
5. What condition arises when the gastric juice begins to digest the walls of the stomach itself?  
*Ulcers are the product of gastric juice damaging the stomach wall.*
6. In what condition is the food mass when it leaves the stomach?  
*It is a liquified product called chyme.*

### small intestine

From the stomach, food passes into the *small intestine*, a tube 7 to 8 meters in length and about 2½ centimeters in diameter. It is in the small intestine that most digestion takes place, and the end products are absorbed into the circulatory system. The walls of the small intestine are in folds, and the lining is in the form of fingerlike projections called *villi*. Both the folding and the villi greatly increase the surface area for absorption.

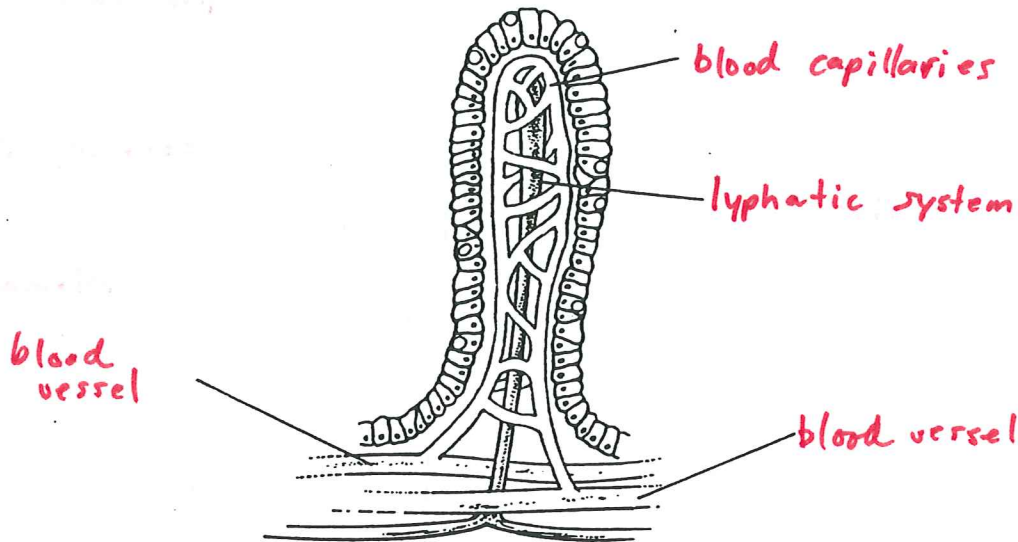
Secretions from the liver and from the pancreas act in the small intestine. *Bile* from the liver emulsifies fats into tiny globules, which present a larger surface area for enzyme action. *Pancreatic juice* from the pancreas contains a number of enzymes; some digest proteins, some starches, and some fats. Glands in the walls of the small intestine also produce protein-, starch-, and fat-digesting enzymes. The end products of digestion—fatty acids, amino acids, and simple sugars—are absorbed into the capillaries and *lacteals* (lymphatic vessels) of the villi and carried throughout the body. Wastes and water pass from the small intestine to the large intestine.

## Questions

1. What are the three parts of the small intestine?  
*Duodenum → Jejunum → Ileum*
2. What happens to proteins in the small intestine, and how are these changes brought about?  
*Proteins into polypeptides into dipeptides into amino acids*
3. What happens to fats in the small intestine, and how are these changes brought about?  
*Bile emulsifies the large fat molecules into smaller ones. Breaks into fatty acids and glycerol.*
4. What happens to starches in the small intestine, and how are these changes brought about?  
*starches into disaccharides then into monosaccharides.*
5. Where is bile produced, and how does it reach the small intestine?  
*Produced in the liver and travels down the common bile duct*
6. How does bile aid in the digestion of fats?  
*to the small intestine (duodenum)  
Mechanically breaks down fat into smaller molecules.*



7. The drawing below shows a cross section of a villus. Label the parts indicated.



8. What happens to simple sugars and amino acids after they are absorbed by the cells lining the small intestine? *enter the blood stream and go to the liver.*

### large intestine, rectum, and anus

From the small intestine, food enters the large intestine, a tube about 2 meters long and 5 centimeters in diameter. No digestion occurs in the large intestine. However, most of the water present in the digestive wastes is reabsorbed in the large intestine. The wastes pass into the rectum, where they are stored temporarily. Eventually, they are egested through the anus.

## Questions

- What is the function of the large intestine?  
*absorption of water and minerals (vitamin production)*
- What types of organisms are found in the large intestine, and what functions do they perform?  
*Live bacteria*

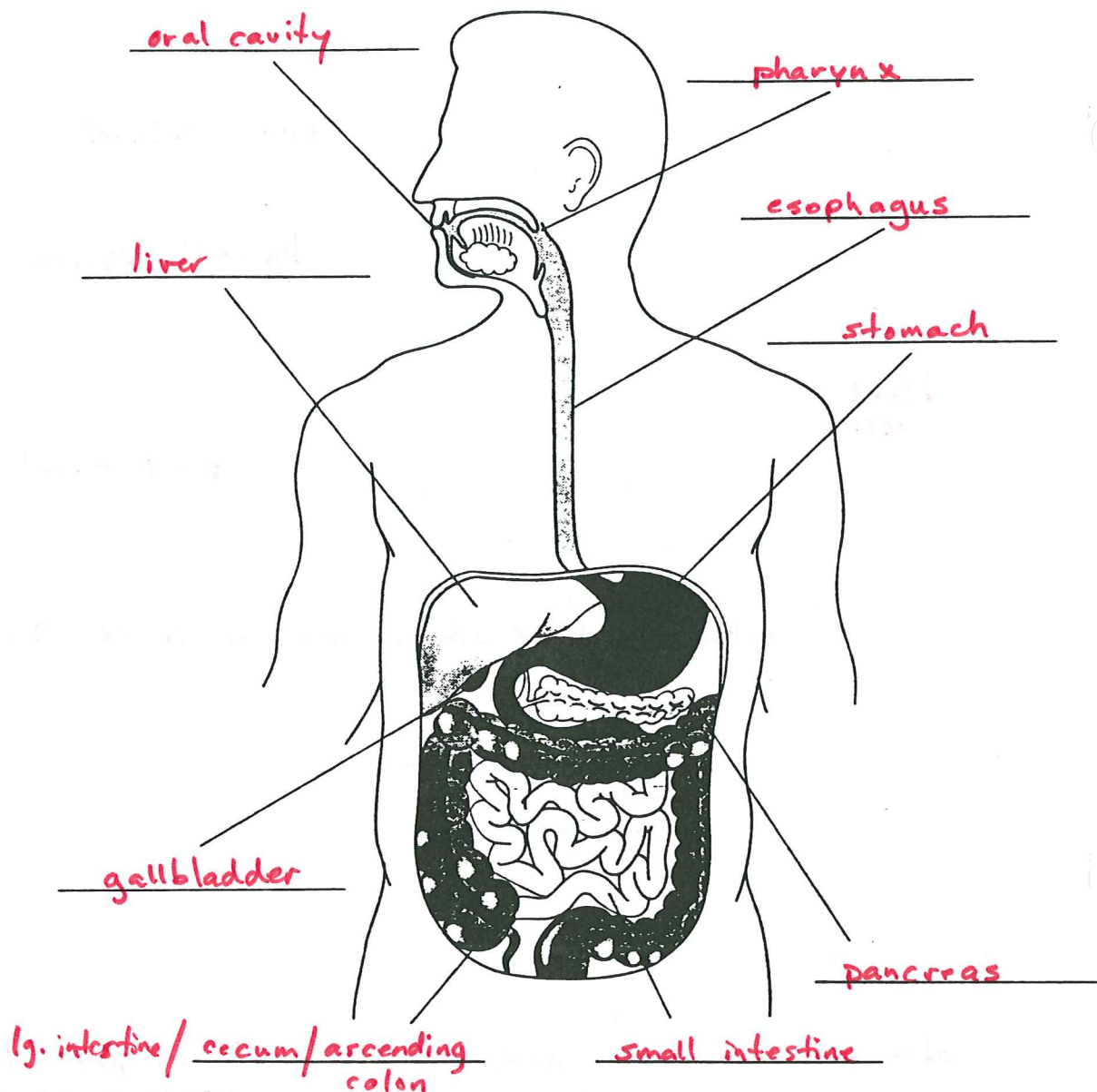
### Food and Digestion: Relating Main Ideas

Pretend that you have just finished eating a steak, a baked potato full of butter, hot rolls with butter, and a green salad with oil and vinegar dressing. Identify the digestive organ in which the chemical digestion of each of these foods would begin. (*Hint: think about the nutrients found in each of these food items.*)

- Steak: *protein and lipids*
- Potato: *carbohydrates*
- Butter: *lipids*
- Rolls: *carbohydrates*
- Lettuce: *no nutritive value → roughage*
- Salad dressing: *lipids*

Label the organs of the digestive system in the diagram below.

4



### Sequencing Events: Applying the Main Ideas

Using the numbers 1 through 8, place the digestive events described below in the correct sequence.

- 6 Chyme moves into the duodenum, where bile from the liver, pancreatic fluid from the pancreas, and enzymes from the intestine itself complete the chemical digestion of proteins, fats, and carbohydrates.
- 4 Peristalsis moves food down the esophagus and into the stomach.
- 2 Saliva begins the digestion of starch.
- 7 As food passes through the jejunum and ileum, nutrients are absorbed into the bloodstream through the villi.
- 5 Churning of the stomach mixes food with gastric fluids.
- 8 Water is absorbed in the colon and solid waste material is prepared for elimination.
- 3 Chewed food passes through the pharynx and into the esophagus.
- 1 Each bite of food is chewed and mixed with saliva.

1. ~~Swimming for one hour burns up 600 Calories. For each food sample you tested, calculate how many grams of food you would have to eat to get this energy.~~

2. ~~Fad diets, which have become popular in the past two decades, involve the consumption of large amounts of a limited variety of foods. Explain why some fad diets may be an unhealthful way to lose weight.~~

3. ~~Although fiber is not officially classified as a nutrient, it is an important component of the American diet today. What is the role of fiber in the human body?~~

4. ~~Contrast the snacks for a person who is trying to lose weight with those for a person who is growing very rapidly.~~

5. Bile is produced in the liver but stored in the gallbladder, where it becomes concentrated before being released into the digestive tract. How would surgery involving the removal of the gallbladder affect the process of digestion? Bile concentration would be reduced so it will not be as effective in emulsifying fat.

6. A person who has had a small section of small intestine removed surgically loses weight.

Explain why weight loss might follow such surgery. Small intestine absorbs the nutrients from food. If you remove the small intestine you reduce the % of absorbed nutrients that could lead to a reduction in weight.

7. Bulimia is an eating disorder in which a person forces the body to eject the contents of the stomach, usually through the mouth. Explain why most bulimics eventually develop dental

problems. Stomach acid (HCl) will erode the enamel of teeth due to continual exposure to the acid.



Fill in the blanks in the following table.

SECRETION	PRODUCED BY	ENZYMES	ACTS ON	BREAKDOWN PRODUCT
Saliva	Salivary gland	Ptyalin	Starch	disaccharides
Gastric juice	Stomach	Pepsin	Protein	di peptides
Hydrochloric acid	Stomach	(none)	Pepsinogen	activates the enzyme pepsin
Bile	Liver	(none)	Fat	mechanical emulsion
Pancreatic juice	Pancreas	Trypsin		
		Amylase	Starch	disaccharides
		Lipase	Fat	3 fatty acids 1 glycerol
Intestinal juice	Small Intestines	Peptidase	Peptides	amino acids
		Lactase	Lactose	2 monosaccharides
		Maltase	Maltose	2 monosaccharides
		Sucrase	Sucrose	2 monosaccharides

### Applying Concepts: Building Vocabulary Skills

1. Replace the underlined phrase with the correct vocabulary term.

- The nutrients in the food you eat are made available to the cells of your body when they are broken down into simpler molecules. digested or hydrolyzed.
- The process of breaking food into smaller pieces increases the amount of food exposed to digestive chemicals. digestion
- Nutrient molecules that can be used by your body's cells are produced during the process of breaking complex molecules into simpler molecules. digestion or hydrolysis
- In the small intestine, digestion is completed and the end products of digestion are transferred from the small intestine to the bloodstream. excreted / removed / expelled
- A series of muscular contractions moves food through the digestive system. Peristalsis

# Structures and Functions: Relating Concepts

Complete the following chart.

Organ	Type of Digestion	Digestive Secretion or Enzyme	Function
Mouth	Mechanical Chemical	Ptyalin in Saliva + Mucous	<ul style="list-style-type: none"> <li>• moisten food</li> <li>• begin starch digestion</li> <li>• chew + grind food</li> <li>• form the bolus</li> </ul>
Esophagus	Mechanical	None	gradual movement of the bolus from mouth to stomach (peristalsis)
Stomach	Mechanical Chemical	Pepsin, hydrochloric acid, and mucus	<ul style="list-style-type: none"> <li>• mucus coats stomach lining</li> <li>• HCl kills bacteria and activates pepsin</li> <li>• begin protein digestion</li> </ul>
Small intestine	Chemical	Peptidase Lactase Maltase Sucrase	<ul style="list-style-type: none"> <li>• final breakdown of disaccharides into monosaccharides.</li> <li>• dipeptides into amino acids</li> </ul>
Liver	None	Bile	• emulsifies fat molecules for easier digestion
Pancreas	None	Trypsin Amylase Lipase	Aids in digestion of proteins and carbohydrates and fats
Large intestine	None	None	<ul style="list-style-type: none"> <li>• absorption of water and minerals</li> <li>• storage of fecal waste.</li> </ul>

